

**FEMTOCHROME<sup>®</sup>**  
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## **FR-103 WS AUTO/CROSSCORRELATOR**



### **Specifications:**

- \* Pulsewidth Resolution: < 2fs
- \* Minimum Pulsewidth: < 10fs
- \* Maximum Pulsewidth: ~ 400ps'
- \* Scan Range: > 500ps'
- \* Sensitivity:  $[P_{av}P_{pk}]_{min}=10^{-7}W^2$  "
- \* Wavelength Range: 410-5000nm
- \* Background-free (non-collinear SHG)
- \* Crosscorrelation
- \* Fiber Coupled/ Free Space
- \* Computer Data Acquisition Option
- ' 1ns scan range w/WSR option
- " w/ PMT [500-1700nm]

The **FR-103WS** is a dispersion-free, NL crystal auto/crosscorrelator for continuous '**real-time**' monitoring of temporal width of ultrashort laser pulses. Offering unsurpassed sensitivity, wide scan range and dynamic range, it is easy to operate. The **FR-103WS** is ideally suited for long pulsewidths (> 100ps), but it is also capable to measure pulses as short as ~ 15fs, from any mode-locked laser over a wide spectral range, for input pulse rep rates > 500Hz\*.

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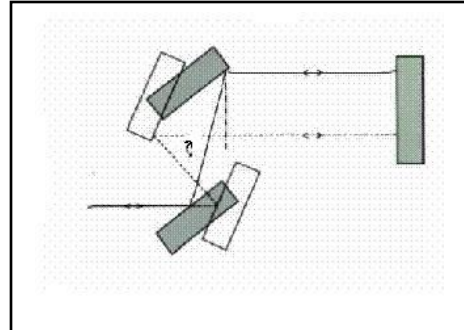
\*input pulse rep rates > 4Hz w/ CDA option

## DISPERSION-FREE, HIGH RESOLUTION

Dispersion is negligible in the **FR-103WS** for pulsewidths down to  $\sim 10\text{fs}$ . Using high reflective metallic-coated optics [the only transmissive element is an ultrathin ( $<1\mu\text{m}$ ) pellicle beamsplitter], an exceptional resolution  $< 2\text{fs}$  [limited only by the NL crystal thickness] is attained.

## PARALLEL (//) MIRROR ASSEMBLY

Rapid scan, periodic optical delay is introduced by means of a parallel (//) mirror assembly.\* Large delays are easily generated, with dispersion-free interferometric resolution.



## WIDE SCAN RANGE/LINEARITY

With its wide scan range ( $\sim 500\text{ps}$ ), the **FR-103WS** is ideally suited for measuring longer pulsewidths  $> 100\text{ps}$ . Its unique mechanism is designed to correct for any delay nonlinearity over such a wide scan range, resulting in an exceptional linear delay.

## SLOW SCAN OPERATION

In this mode of operation of the **FR-103WS**, the // mirrors slow down greatly (3 selectable speeds) over a period when the pulses on the two arms of the Michelson Interferometer set-up are overlapping. The // mirrors speed up beyond this range, to return quickly for a repetition of the cycle. This mode renders the unit suitable for '**real-time**' autocorrelation of lasers with any rep rate  $> 500\text{Hz}$ . [Input rep rates can be as low as  $4\text{Hz}$  w/ CDA option].

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\* Z.A.Yasa and N.M.Amer, Optics Commun., V36, 406 (1981)

## **HIGH SENSITIVITY & WIDE DYNAMIC RANGE**

The remarkable sensitivity of the **FR-103WS** is demonstrated by its noise equivalent signal level of  $[P_{av}P_{pk}]_{min} = 10^{-7}W^2$  \*. This is further augmented by an unprecedented dynamic range of  $\sim 10^4$ .

These remarkable figures render the **FR-103WS** powerful for the measurement of weak satellite pulses which commonly occur with modelocked lasers:

## **WAVELENGTH RANGES (/BBO/KDP/IR/xxxx)**

Three optimal **NL crystals** provide operation to  $\sim 5000nm$ . The standard unit comes with one customer specified NL crystal:

/BBO → 410-600nm  
/KDP → 510-1100nm  
/IR → 850-5000nm.

These NL crystals accept **vertically** polarized input beams, they are BBAR coated and fundamental blocking filters are provided for their operational range. For long term reliability, a desiccators is provided to protect the crystal when not in use. The standard NL crystal thickness is customer specified (0.1mm/0.3mm/1mm), with attention to the trade-off between resolution (thinner NL crystal) and sensitivity (thicker NL crystal).

Generally, a 0.3mm crystal thickness can be considered sufficient for pulsewidths down to  $\sim 30fs$ . With shorter pulses, a thinner crystal is necessary. For sub 10fs pulsewidths, a custom ( $<25\mu m$ ) NL crystal thickness will need to be specified.

## **/xxxx PD modules for extended IR wavelengths**

The photomultiplier (PMT) in the standard **FR-103WS** covers the 410-1800nm operation. This range can be extended in the IR, by plug-in photodiode (PD) modules (/xxxx) which mount in front of the PMT enclosure. The PD module selections are:

/1300 → 1300-2200nm  
/2200 → 2200-3400nm  
/3000 → 3000-5000nm

Sensitivity is greatly reduced when operating with these PD modules since they lack the gain as provided by a PMT. Typically, a minimum of  $\sim 5mW$  avg. power is needed for a subpicosecond modelocked pulse, over the wavelengths covered by these modules.

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\* Over wavelengths 550-1700nm, PMT operation w/ 1ps integration time, and a NL crystal thickness of 1mm.

## **OPTIONS:**

### **CROSSCORRELATION (/CC)**

The **FR-103WS** has a built-in auxiliary port for crosscorrelation of two spatially separate synchronized beams. No additional optics is necessary for this mode of operation.

### **FIBER ADAPTER OPTION (/FA)**

An optional gimbal mount with a collimator is installed over the variable input aperture of the **FR-103WS**, for easy connection of fiber-coupled beams. Factory aligned, repeated connections without a need for realignment is facilitated. The /FA is easily removable for a free-space input beam. Its standard adapter is FC [FC/PC or FC/APC]. For operation at 1550nm, a PM-DSF patchcord can be attached to the /FA. The collimator of the /FA is focus adjustable to obtain good collimation if it needs to be used over greatly different wavelengths. A  $\lambda/2$  plate holder is also provided within the /FA assembly, for users to install one for their wavelength of operation, if needed for polarization control. The /FA option can also be applied to the CC port [/FA(CC)].

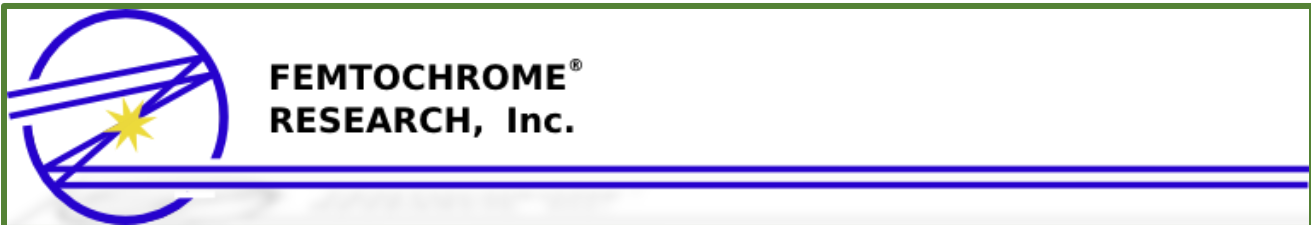
### **COMPUTER DATA ACQUISITION OPTION (CDA)**

A data acquisition board is installed in the **FR-103WS/CDA**, providing an interface (USB) with any PC w/ Windows OS. Its associated software allows traces to be displayed, analyzed [averaged and/or fit with typical pulseshapes (Gaussian and Sech<sup>2</sup>)] or saved.

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- \* Scan Range: > 500ps (1ns w/WSR)
- \* Sensitivity:  $[P_{av}P_{pk}]_{min}=10^{-7}W^2$  [w/PMT over 550-1700nm]
- \* Wavelength Range: 410-5000nm
- \* Background-free (Non-collinear SHG)
- \* Fiber Coupled/ Free Space
- \* Crosscorrelation Option
- \* 'real-time' autocorrelation for any input rep rate > 500Hz
- \* Computer Data Acquisition Option



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